

## 2 Project Management Principles

Project management is a systematic process of planning, budgeting, scheduling, staffing, directing, and controlling of a set of related and interdependent activities to achieve a desired objective.

Formally, project management is defined as the judicious use of resources to achieve a prescribed objective. The resources referred to here are time and cost, and the prescribed objective is the desired level of performance (owner satisfaction) for the project. The three criteria of time, cost, and performance jointly define the performance indicators of project success. The following figure depicts the space for all possible project outcomes. The optimum result usually falls within the defined limits for time, cost, and performance. This optimum result can be achieved through a series of trade-off analyses where the most favorable combination of time, cost, and performance is settled on.

Today, public agencies are under severe public scrutiny to reduce overhead and improve productivity. Industry provides stiff competition and the public is demanding more accountability. As budgets get tighter, pressure to reduce cost by eliminating functions or streamlining the processes becomes more pronounced. The bottom line for public agencies is to reduce bureaucracy and become more competitive.

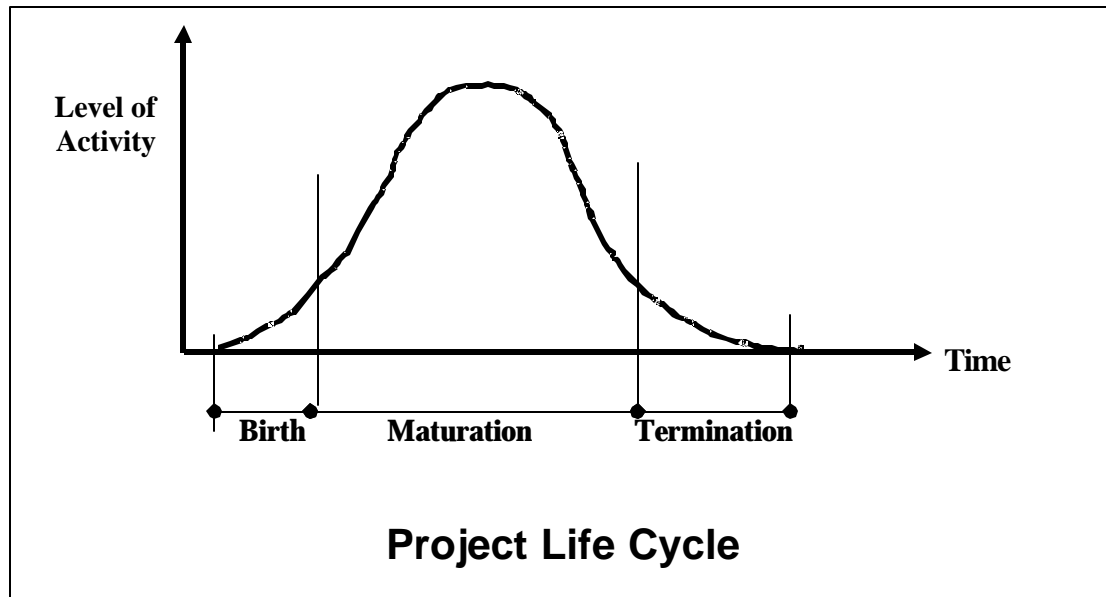
**Project management provides the necessary tools for an organization to utilize its human and financial resources more effectively.**

To effectively apply the project management concept, one prerequisite is a clear understanding of the process and its constituent components. There are five major components to the project management concept. The following paragraphs present details of these components.

### 2.1 *The Project*

The project consists of a set of related activities that collectively produce an outcome to fulfill a specific objective. A project has a three-phase life cycle: birth, maturation, and termination. The following diagram represents a project life cycle. At birth, the rate of progress is slow while the project is being organized and initiated. During the maturation period there are flurries of

activities and the pace of progress increases and then starts to decrease as the project approaches the termination phase. During the termination phase the rate of progress is the slowest while the project is readied for completion and turn over.



**Figure 2-1**

All projects share four common characteristics.

- They have goals.
- They involve interrelated activities.
- They have a limited, finite duration, with beginnings and ends.
- They are unique.

## **2.2 Project Manager (PM)**

A successful project requires effective leadership from a project manager (PM). The PM is responsible for carrying out the project by insuring that all project activities are completed in accordance with time and budget requirements and at the highest level of quality. To do so, the PM must assemble a project team of functional specialists (experts) to accomplish the individual tasks of the project.

The undisputed leader of the project team, the PM has the ultimate responsibility for the success or failure of the project. The PM is a generalist rather than a specialist. Typically, the PM does not have the time or the skills to personally execute each detail within the project. The PM must

depend on the team members having the necessary skills to get the job accomplished. The PM must provide overall direction, guidance, and motivation. The PM is:

- a team builder
- a motivator
- a communicator
- a listener

The PM is also:

- problem-oriented rather than discipline-oriented
- a synthesizer rather than an analyzer
- a facilitator rather than a supervisor

So, where do project managers come from? Obviously, no one is born with project management skills. Project management skills can only be acquired through experience of trying different approaches and then identifying what works and what doesn't. At times, this experimentation can lead to disastrous results in getting projects finished on time and within budget. A lucky project manager attains skills through long-term training while being mentored and guided by an experienced and successful PM. Unfortunately, many project managers start their careers without such valuable guidance.

**A good project manager will do what it takes to complete the assignments and meet the overall project objectives.**

A PM's career path usually starts in one or more functional work areas. As the individual's level of responsibility grows, so will their skills in decision making and working with others. This type of experience may eventually lead to the development of leadership skills. Finally, one will develop expertise in few areas, while possessing only general knowledge in others.

A new PM has a tendency to concentrate efforts on familiar technical tasks. As an inexperienced PM is more knowledgeable in specialized areas, they have the tendency to allow other work to progress at the discretion of the team members. In such cases, the PM will let the project fail by inadequately controlling the overall project operation.

**An experienced project manager concentrates on providing leadership by getting involved with high level issues rather than “getting lost in the weeds.”**

PMs should separate themselves from the day-to-day technical tasks and concentrate on effectively managing and controlling the many varied operations. Once a functional expert is moved from a functional area to project management, they must give up their safety net of controls provided by senior functional engineers. New PMs will learn that, for most part, they are “flying solo.”

The PM’s efforts are generally concentrated on examining various situations and deciding what things should be done to accomplish the desired end, regardless of whether or not they follow the patterns set on previous projects. In doing so, they must remain cognizant that they have responsibilities to the parent organization, the project, and the project team. In meeting these responsibilities, the PM will face the difficult task of dealing with conflicting objectives. A successful PM will create goals that are satisfactory to the parent organization, the project, and the project team.

**The project manager is the coach who develops a game plan around the team’s talents. The team’s ultimate success depends on the coach’s appreciation of the team’s capabilities.**

A successful PM has self-motivation and skills to confront and challenge adversity. Their knowledge of functional areas will help in scheduling and directing the functional activities of the team members. They must constantly advise and illustrate to the project team how their assigned activities will affect the completion of the project. The PM’s goal is to build a close-knit team working toward a common objective.

To achieve the project objective, the PM must portray an image dedicated to excellence, discipline, optimism, and confidence, never faltering in the leadership role. They should cultivate a team culture founded on knowledge, cooperation, innovation, and understanding of basic human needs with regard to self-actualization and fulfillment. They should demonstrate high performance standards and demand the same from each team member while remaining reasonable, sympathetic, and understanding of failure due to special circumstances.

## 2.3 *Project Team*

The project team is an assembly of specialists (experts) that come together—from within and outside of the organization—for a limited time to work on a specific project. During this period, the team dedicates itself to successful completion of the project under the leadership of the project manager. Each team member is selected because of his/her unique talent and capability necessary in meeting the specific requirements of project objectives. An astute PM attracts only the very best as part of their team.

**Project management requires active participation by members of the project team; it is not a spectator sport.**

In public agencies where the organizational structure is pyramidal with imbedded silos representing functional areas, pulling a prospective team member out of a silo requires negotiation with the manager of the functional area. While the PM does not have direct authority over the prospective team members, they have the right and responsibility to request the allocation of the best available talent to their team. Often, due to competing schedules, the PM may not be able to get a specific individual or group as part of the team. The final decision over what resources are provided rests with the various functional managers from which the team members are assigned. At times when the PM and functional manager disagree, it will be necessary to elevate the issue to higher levels in the organization, with the possibility of the functional manager's decision being over-ruled. In any case, the affected functional manager should provide the best available resources to the project manager. Occasions like this call for special negotiating talents and an astute PM would not create a conflict that will have long term consequences. Once assigned to a team, the individual team member is responsible for completing their assigned task in the timeframe designated by the PM.

**The project manager plans, schedules and directs the project.  
The functional specialist performs the assigned activity.**

An effective PM grasps the role of the team's functional specialists and recognizes them as the technical experts. If the specialists believe that certain technical portions of the PM's requirements are unsound, they have the responsibility, by virtue of their expertise, to present their case to a higher authority.

**Project managers' universal credo: "To get the job done!"**

The most important responsibility of a PM is to generate interest and enthusiasm in the team members for the project goals. The team members must adopt the project goals as their own. In developing detailed plans and schedules for project tasks and activities, the PM and functional specialists assigned to the team work together to develop a plan that is acceptable to all. Ultimately, the PM's plan must become the team's plan.

## **2.4 Project Management Process**

To have a successful project, a capable PM follows a project management process. Such a process must be sufficiently flexible and robust to allow adaptation to various project types. Nevertheless, there are four major functions that are fundamental to such a process. These four functions are:

- Project Planning
- Team Building
- Directing Function
- Control Measures

The degree of effort required for each of the above functions varies with the size and complexity of the project. For example, a simple pavement overlay project may require minimal effort in one or more of these areas, while major projects could require considerable effort. The PM must determine the appropriate amount of effort required in each area to insure the successful completion of the project. The following paragraphs provide further details for the four functions.

### **2.4.1 Project Planning**

Planning a project is the process of deciding, **"What must be done?"** It entails a series of activities designed to ensure that the project is completed on time, within budget, and with an outcome that meets expectations. Project planning requires complete familiarization with all aspects of the project. It is the first step of the project management process. Regardless of the phase of the project—the project may be in feasibility, planning, funding, design/development, letting, or the construction phase—the result from project planning must ensure that the overall

project objective can be achieved. The outcome of the planning function is a document called the Project Plan. Appendix 1 provides details of a Project Plan.

Project planning includes considering schedules and budgets. Scheduling establishes timelines and milestones for the completion of tasks and activities that makeup the project. The project budget identifies the resources needed, when they are needed, and an understanding of the sources through which the project is to be financed. The following sections detail these two areas.

**Project Schedule:** Project scheduling responds to the question of **“When is it going to be done?”** It is the process of sequencing project activities in a logical and systematic way, setting target deadlines for each activity. Scheduling also determines milestones. Once a project schedule is established, the challenge is to allocate appropriate resources to each activity and task so that the project is completed according to the schedule. In the scheduling process, some critical activities will control the project completion date. Conversely, some activities will be float activities meaning that if they are delayed within their float period, the project will not be delayed. An experienced PM will constantly watch the critical activities. A critical path method (CPM), described later, is normally used to develop comprehensive schedules of critical and float activities.

**Project Budget:** Project budgeting deals with the question of **“How much is it going to cost and what are the sources of funds?”** Budgeting applies to the costs associated with each activity or task. As the project progresses, accumulated costs are compared to the established budgets, and in the case of cost over-runs, corrective measures are taken to adhere to budgetary requirements. At times, it may be necessary to update the budget figures, but, ideally, budget figures should never be adjusted. A project will include a variety of costs including material and labor, direct and indirect. Care must be taken to include all costs in the budgeting process.

## **2.4.2 Team Building**

Building the project team (staffing process) basically deals with finding the right person to do a specific task in a competent manner. The staffing function answers the question of **“Who is going to do it?”** Answers to this question involve determining staff level requirements for each task, the duration of engagement for each team member, and where each team member is going to come from. The team members come from inside the organization or are from an external consulting firm. As a matter of fact, if services of a consulting firm are utilized, the entire staff of that firm can be considered as potential team members.

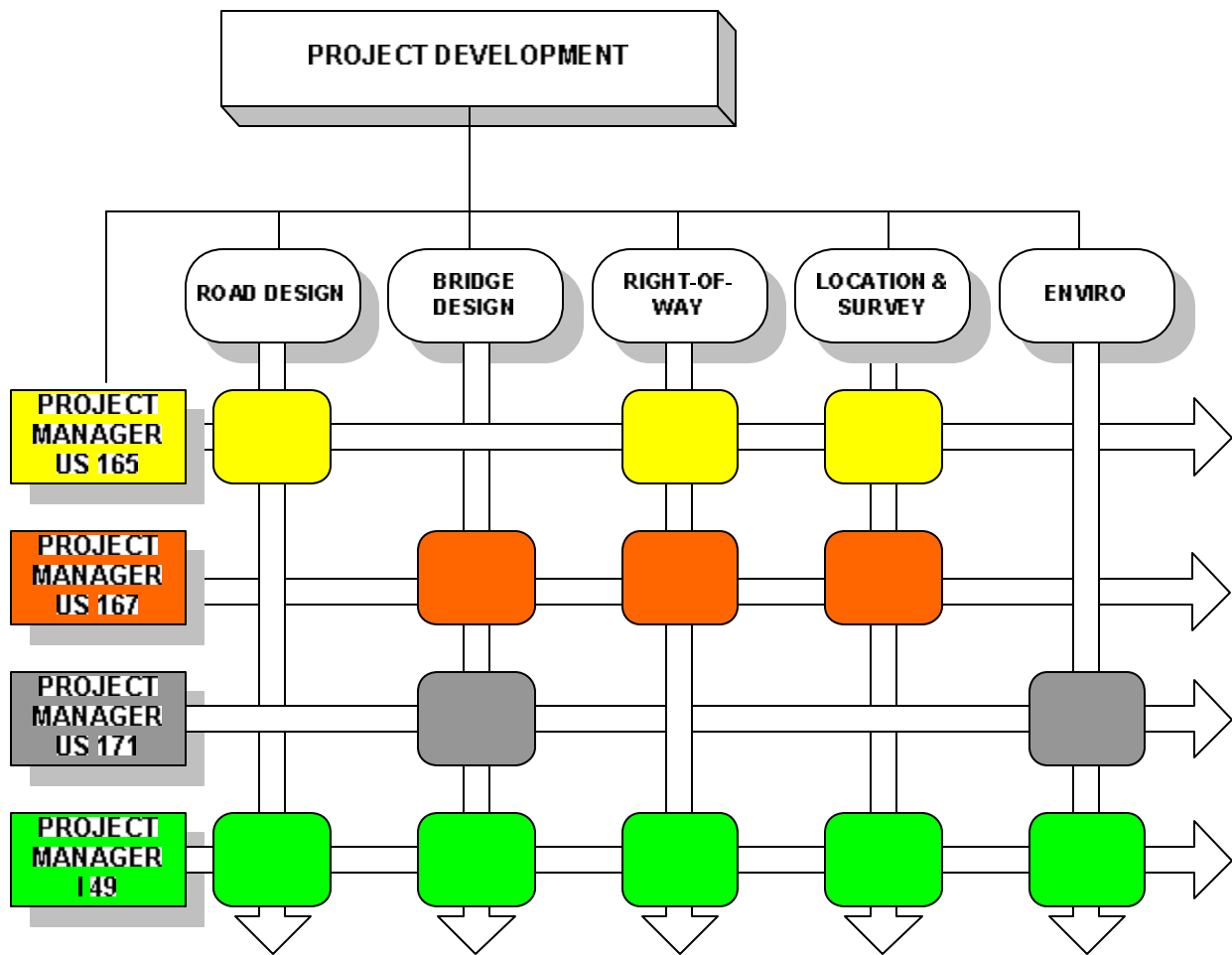
The team members assigned from within the organization are usually housed in specialized functional areas and tend to work independently within their technical expertise. This is more typical in public organizations than private firms. The functional areas in a public organization are sometimes referred to as “silos” to demonstrate the rigidity of the organizational structure.

Once assigned a project task, a functional specialist is considered as a team member of the project in question. These functional specialists perform similar tasks for many different projects. Once a functional specialist has satisfied the needs of a project assignment, they become available for other assignments.

The project manager and the functional manager establish priorities for the completion of the tasks on each project. In setting these priorities, the functional manager has the difficult task of scheduling functional specialists’ activities to provide the necessary support to a project manager for successful completion of the project.

The following figure depicts the formation of project teams through staffing from various functional areas in a functional organization. The functional areas run vertically and serve as resources. The individual projects run horizontally across the matrix utilizing specific resources from each functional area. The PM is responsible for coordinating and integrating activities across multiple functional lines and as such must be generally familiar with the operations of each functional area.





**Figure 2-2**

In public as well as private organizations, which are functionally structured, continuous support and encouragement from upper management will be needed to effectively implement a project management process. There are a number of individuals or groups that influence successful development of a project. They are:

**Upper Management:** plays a supportive role in providing adequate resources to the functional and project managers. Members of upper management play the role of facilitators and at times become referees. They usually do not have direct involvement in a project unless the project is large or highly visible. On the plus side, the highly visible project will probably receive greater support, which will make it easier for the PM to

attract the best talent and acquire the needed resources. On the negative side, upper management may find it irresistible to meddle in the project, leaving the PM in an awkward position.

**The Project Manager:** is responsible for the timely performance of the assigned project, but does not have direct authority over the functional personnel. The PM accomplishes the mission through effective communication and persuasive skills, especially in dealing with the functional managers.

**Functional Managers:** have responsibility for various divisions and sections in the organization. Each division maintains expertise in one or more functional areas to provide the required services. As the PM organizes a project team, they must negotiate with functional managers for resources. Therefore, it is important that the PM maintains a positive interpersonal relationship with the functional managers. In negotiating for resources, it is possible that a functional manager will not commit the availability of certain individuals to a project. If the PM is fully convinced (by the evidence) that the assigned personnel are unacceptable, he should discuss this with the functional manager, if necessary, and elevate the issue to a higher level.

**Functional Specialists:** perform detailed and usually technical tasks in a project. Often they have to cope with strenuous deadlines and simultaneous demands with limited resources. They usually face conflicting priorities on different projects and meet unscheduled changes in the project plan. They may be the “unsung heroes” of the project team.

**Consultants:** are utilized when sufficient resources are unavailable or specialized expertise is needed. As such, the consultant’s staff will work in a team environment with the assigned staff from within the agency. Usually, when a consulting firm is utilized, internal staff appointment is kept to a minimum. However, the PM’s role will be somewhat different. First, the PM’s relationship to the consultant will be formal and constrained as defined by the contract. Therefore, the PM should have substantial knowledge of the provisions in the contract executed with the consultant. It is always advantageous for the PM to have an effective role in negotiating the contract. Second, while the PM does not have direct responsibility for the internal operation of the consultants, they must remain fully informed of the consultants’ activities since their performance will determine the success or failure of the project. In short, the PM must balance two extremes: he/she cannot manage the consultant’s staff, but he/she must

remain fully informed of the project progress and when necessary do all that can be done to ensure the project's success.

**Cooperating Governmental Agencies:** are usually state and federal agencies that have regulatory responsibilities over the impacts that a project may have., These agencies usually deal with environmental issues. Because the success of the project depends on the cooperation of these agencies, the project manager must be fully conversant with the regulatory requirements and policies that concern the project. For example, the PM must be knowledgeable of the environmental regulations governing all permits and authorizations.

### 2.4.3 Directing the Project

Directing is the process of guiding each activity to its timely completion within its assigned budget. Directing responds to the question of **“How is it being done?”** Directing requires that the staff members be familiar with the project and their individual responsibilities, be knowledgeable about the technical issues, and dedicate themselves to successfully complete the project. To develop an effective directing function, the PM should:

- Direct all activities related to project management function - plan to meet all contractual obligations.
- Develop a strategy for team operation – establish written guidelines and clearly define responsibilities and restraints.
- Develop and implement decision process within the project team – ensure that decision authorities are well understood by the team members.
- Establish performance goals for the project and members of the project team.
- Promote the growth and professional development of the project team members.
- Foster and develop a spirit of project team effort.
- Take an active role in conflict resolution between departments or groups.
- Maintain current knowledge of overall project status.
- Maintain effective communications with all partners, team members, participating governmental agencies, and others performing project work.
- Monitor project activities for compliance with the agency's general policies, mission and philosophy.
- Interpret, communicate, and require compliance with project procedures, contracts, the approved plan, and directives.
- Maintain personal control of adherence to contract requirements.

- Ensure adherence to time and cost schedules – take necessary steps to meet milestone targets.
- Closely monitor project activities for conformity to project scope provisions.

#### **2.4.4 Control Measures**

The control process consists of three distinct but related activities:

1. Monitoring the actual progress of the project; i.e., measuring the performance,
2. Evaluating the progress to ensure that the project objectives are being met; i.e., project is on time, within budget, and at the desired level of quality, and
3. Taking corrective actions to put the project back on track when there is deviation from the schedules and budget.

The control process ensures that the project “is being done” in accordance with the approved objectives (schedule, budget, and quality). The PM dynamically controls the project by establishing goals and schedules. They oversee the project to a successful completion through constant monitoring and providing direction. The PM looks at what has been accomplished on the project and compares progress with the original schedule, goals, and objectives. They then take necessary steps to overcome major variances between progress and the original requirements.

### **2.5 Project Management Tools**

As previously described, two important issues in project management are scheduling and controlling. Through scheduling, time and resources are allocated to various activities that make up a project. The control function ensures that the project remains on track until completion without exceeding the allotted time or the budget. At times, there will be variances from the “game plan” for the project. As long as the future holds some uncertainty, project plans will be inexact. In controlling a project, the question is not whether there are variances, but whether the variances are small enough to be acceptable. When the variance is not acceptable, corrective measures must be taken to overcome it. In such a case, the project manager must quickly consider and analyze all related information and situations and implement corrective actions to place the project back on track.

Application of the project management process requires utilizing appropriate management tools. As everything will not go according to plans, midcourse adjustments will be necessary

periodically. In deciding what course of action is most appropriate, the PM must perform a series of analyses to arrive at the best decision. The tools necessary to aid a PM in performing such analyses fall into three categories:

- Scheduling tools
- Financial tracking tools
- Management reporting tools

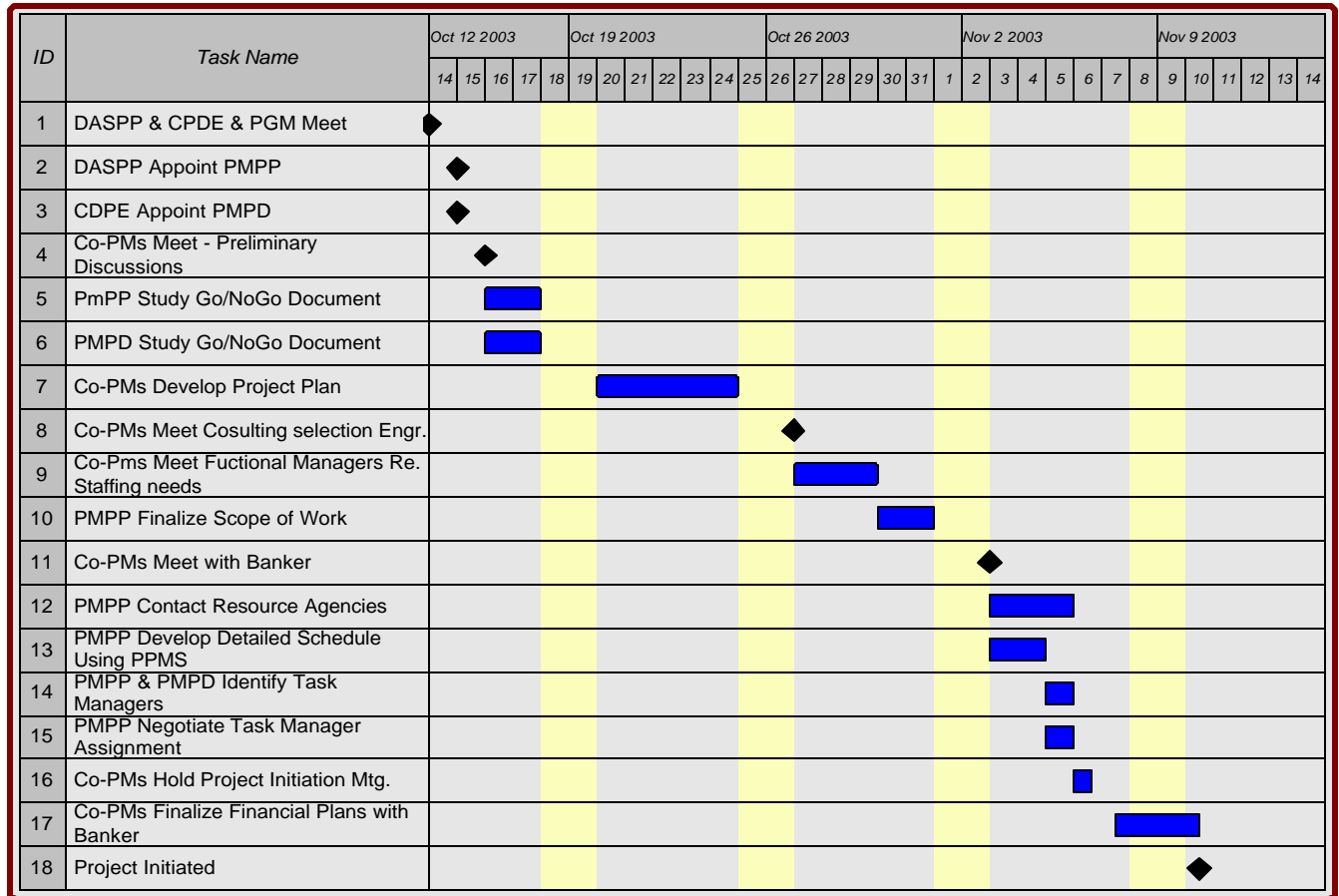
Scheduling tools are used to establish and track timelines for tasks or activities that make up a project. A scheduling system provides for timely information on the progress of a project and allows the PM and the project team to make the necessary adjustments so that the project can meet its established timeline. The following sections outline various scheduling tools. Today, there are many sophisticated scheduling systems available in the market.

Financial tracking tools are for keeping track of project expenditures and for comparing the actual amounts to the budgeted amounts. Completing a project within its allotted budget is as important as finishing the project on time. Today's project scheduling tools are also capable of financial tracking and providing detailed financial reports.

Management reporting tools produce the time schedule and financial reports for the project. There are several levels of reports, from a very detailed task level report to highly summarized, upper level management reports. Normally, the level and types of reports are influenced based on the complexity and size of the project. A robust project scheduling and management system will have the necessary capabilities to produce a variety of reports.

### **2.5.1 Gant Charts**

A Gant Chart is a simplified means to represent project activities, their dependencies, and each activity timeline in a graphical form. The chart consists of a time scale and wide bars representing activities and tasks. Each bar depicts when the task is to start, how long the task will take to accomplish, and when the task will be completed. Gant Charts are considered elementary project scheduling tools and are usually used for presentation purposes only.



**Example Project Gant Chart**

**Figure 2-3**

## 2.5.2 CPM and PERT

The two most widely accepted methodologies for project scheduling and control are Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT). CPM was developed in 1956 by E. I. du Pont de Nemours' Construction Division in collaboration with Sperry-Rand Corporation. Since its inception, CPM caught the eye of the construction industry and is now in wide and general use for management and control of projects.

The Program Evaluation and Review Technique (PERT) was developed in 1958 by Booz-Allen and Hamilton, a systems consulting firm, for the U.S. Navy. The success of the Polaris Missile development program, completed two years ahead of schedule, is largely attributed to PERT's usefulness and effectiveness.

Today, the terms CPM and PERT are used synonymously to represent the CPM method. CPM is a powerful scheduling and management technique for all types of projects. It is deterministic; that is, project duration is determined based on information that is specified with certainty. CPM operates based on the principle of “management by exception.” It focuses attention on the activities that directly affect the overall duration of the project. By concentrating only on the critical activities—in contrast to all activities—ample opportunity is provided for the management to devote more time to project control and thus increase chances for project success.

Both CPM and PERT require that a project network be constructed first. This network is a schematic representation of the project activities and their interrelationships to each other. In other words, the project network is a topological representation of the project and establishes the sequence of events. A properly developed project network is used as the tool for defining all dependencies among various entities. It not only depicts the sequence of events and activities, it also provides the timelines that these activities and events are to be performed.

Next, the network is used to determine starting and completion time of each activity. The process identifies all critical activities and events that control the project completion date. The final use of the network is to establish how and when the available resources are to be allocated to various project entities. During the project execution phase, the network becomes the instrument for control. It permits the periodic review of activities as affected by the uncertainties of the planning phase and allows for reevaluating the incomplete tasks and initiating remedial measures.